

ON THE OSTEOLOGY OF *TRIENOPS PERSICUS*,—by G. E. DOBSON, B. A.,  
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(With plate VI.)

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The construction of the bony skeleton shows a closer relationship with *Phyllorhina* than expected by me, when writing my description of the genus, founded on the typical species of which I had not then obtained a perfect skeleton.

The genus is connected with *Phyllorhina*, principally, in the relative number and length of the bones of the fingers, supporting the wing membrane; in the relative number and length of the bones of the toes; in the shape of the iliac bones; and less markedly in the flattened form and vertical height of the nasal bones. In some other respects, especially in the form of the bones entering into the construction of the *basis cranii*, and in their foramina, its relations are more closely with *Rhinolophus*, while it differs from both genera, not less importantly, in some peculiarities of structure to be described hereafter.

I shall, therefore, in describing the bones of the skeleton compare them generally with those of the species of *Phyllorhina* and *Rhinolophus*, and particularly with those of *Ph. larvata*, Horsf., portions of the skeleton of which are figured in the accompanying plate for the purpose of comparison.

In its general outline the skull resembles that of *Phyllorhina* more closely than *Rhinolophus*, especially in the flattened form and less vertical height of the nasals, which are, however, relatively, much more developed laterally and vertically, than in the former genus. From both genera it differs remarkably in the form of the zygomata which are greatly compressed, and expanded in a vertical direction.

The superior margin of the zygoma rises vertically to a height of 0·15 inch immediately in front of the posterior origin of the arch, maintaining this height for more than two-thirds its length, then suddenly narrowing to half near its connection with the maxillary; the inferior margin is straight, and the intervening bony structure very thin and diaphanous. The zygomata are not curved outwards, as in *Phyllorhina* and *Rhinolophus*, and their flattened arches form straight lines with the sides of the maxillæ.

The *basis cranii* is much narrower than in *Phyllorhina*; the basi-occipital is less than half the width of that of *Ph. larvata*, the total lengths of the skulls being, respectively, 0·85 and 0·95 inches.

The following table of dimensions shows the principal measurements of the skulls in *Tr. persicus* and *Ph. larvata*:—

	<i>Tr. persicus</i> inches.	<i>Ph. larvata</i> inches.
Extreme length of skull,.....	0.85	0.95
Breadth between upper margins of zygomata,	0.30	0.50
Breadth across nasal prominences,.....	0.28	0.28
Greatest vertical height of zygoma, .....	0.15	0.10
Length of zygoma, .....	0.18	0.23
Length of bony palate, laterally, .....	0.24	0.23
Width of basi-occipital between the cochleæ,...	0.04	0.10
Length of base of skull from posterior margin of palate to edge of foramen magnum, .....	0.37	0.43
Width of the base of the skull behind poste- rior roots of zygomata, .....	0.32	0.42

The auditory *bullæ osseæ* are very large and prominent; the cochleæ are deeply grooved externally by the intervals between the spiral chambers, contrasting with the smooth external surface of the much less prominent cochleæ of *Phyllorhina*, and resembling more closely the same parts in *Rhinolophus*.

The par-occipital processes are long and slender, club-shaped, narrow above, expanded beneath, directed downwards and slightly forwards, terminating in a small, acutely pointed projection directed forwards, supporting the inferior surface of the petro-mastoid. In *Phyllorhina* the par-occipital processes are very short and blunt; in *Rhinolophus* long and slender, directed downwards and forwards, slightly thickened beneath.

There is a minute precondyloid foramen on each side, and in front of, and external to it, a wide opening—having for its anterior boundaries the petro-mastoid and cochlea—the jugular foramen. There is no distinct carotid foramen. In *Phyllorhina larvata* the precondyloid foramen is separated from the jugular opening by a considerable interval; the latter is small, circular, and occupies the angle between the petro-mastoid and cochlea.

The basi-sphenoid is perforated, posteriorly, in the middle line by an oval aperture, a defect of ossification, represented in *Phyllorhina* by a circular thinning of the roof of the *basis cranii* in the same situation. Between this aperture and the glenoid fossa is a circular opening, the foramen ovale, placed posterior and slightly external to the sphenoidal fissure. More posteriorly and externally, behind the glenoid fossa, separated from the petro-tympanic bulla by a narrow bony process, a large post-glenoid foramen exists, while immediately external to and above it the squamosal is perforated by a small venous canal directed upwards.

The roof of the meso-pterygoid fossa is pierced posteriorly by two small foramina placed one on each side of the middle line, and separated by an exceedingly narrow bony lamella, and similarly in front, near the junction

of the basi-sphenoid with the pre-sphenoid. The cribriform plate is perforated by two large triangular foramina separated by a narrow bony process.

The pterygoid plates are greatly expanded, forming broad, acutely pointed, triangular projections directed downwards and slightly outwards, giving width to the meso-pterygoid fossa which quickly narrows as it proceeds backwards, exposing the wide sphenoidal fissures. Posteriorly its roof becomes continuous with the under surface of the *basis cranii*, as in *Phyllorhina*, its sides curve outwards, forming the posterior boundaries of the sphenoidal fissures which extend backwards as far as a line drawn between the glenoid fossæ. There is no distinct foramen rotundum.

In *Phyllorhina* the sphenoidal fissures are much narrower and shorter, terminating posteriorly at some distance in front of a line joining the glenoid fossæ. They are concealed in their whole extent by the lateral walls of the meso-pterygoid fossa. The foramen rotundum is represented by a small aperture in front of, and internal to the foramen ovale which occupies the same position, relatively, as in *Triænops*. The post-glenoid foramen is small or absent. The meso-pterygoid fossa maintains the same width from before backwards, or is slightly expanded posteriorly. About the middle its lateral walls develop small, acutely pointed, hamular processes, curved backwards.

In *Rhinolophus* the basi-occipital is extremely narrow between the auditory bullæ; the foramen rotundum is united, as in *Triænops*, with the sphenoidal fissure which extends as far backwards as in the latter genus; the meso-pterygoid fossa is relatively wider anteriorly than in either *Phyllorhina* or *Triænops*, and conceals the narrow sphenoidal fissures to within a short distance of its termination where its sides suddenly narrow, disclosing the sphenoidal fissures posteriorly, and slightly further backwards curving outwards limit their posterior extent; its roof is traversed by a narrow groove terminating posteriorly in an excavation, thus differing from both *Phyllorhina* and *Triænops*.

The bony palate extends as far back as the middle of the last molar tooth; in *Phyllorhina*, it is limited by the posterior margin of the second molar.

The coronoid process of the mandible is very small, and in vertical height less than the canine tooth, thus resembling *Rhinolophus* more than *Phyllorhina*; the upper margin of the articular surface is level with the summits of the molar teeth, and the ramus is pierced immediately beneath and in front of the condyle by a large circular foramen directed upwards, and slightly outwards.\*

\* This infra-condyloid foramen of the mandible is probably unique in *Triænops*, in no other genus of *Rhinolophidæ* have I found it, nor, so far as I can ascertain has such a foramen been discovered in any other species of *Chiroptera*.

In *Ph. larvata* the coronoid process of the mandible exceeds the canine tooth considerably in vertical extent, and the upper margin of the condyle is raised above the summits of the molar teeth.

The dental formula corresponds with that of *Phyllorhina* :—

In.  $\frac{2}{4}$  ; c.  $\frac{1-1}{1-1}$  ; p. m.  $\frac{2-2}{2-2}$  ; m.  $\frac{3-3}{3-3}$ .

The upper incisors are deeply bifid, and, as in all genera of *Rhinolophidæ*, minute, placed near each other in the centre of the space between the canines at the extremities of rudimentary premaxillæ suspended in the nasal cartilages. The upper canine has a well developed, acutely pointed talon behind, in front a raised ridge extending nearly half its vertical extent and terminating in a small blunt projection. The first upper premolar is minute with a slightly concave crown, it is placed outside the tooth-row; the last molar is considerably more developed than in *Phyllorhina* and resembles that of *Rhinolophus*, equalling, in the antero-posterior diameter of its crown, more than three-fourths the second premolar, while in *Ph. larvata*, *Ph. nobilis*, and other species of *Phyllorhina*, it is less than half.

In the lower jaw the incisors are deeply bilobed; a faint indication of a third lobe is discernible with the aid of a lens, on the outer side of the outer incisor.

The first premolar has the cingulum largely developed, expanded horizontally on all sides, and sending upwards, anteriorly and posteriorly a small process, so that the tooth appears, at first sight, tricuspidate. The posterior process is much more vertically extended than the anterior one.

The third molar equals the second in size, contrasting with the imperfectly developed last molar of *Phyllorhina*.

The manubrium sterni differs remarkably from that of *Ph. larvata* which may be taken as characteristic of the form of this bone in *Phyllorhina*. The lateral processes behind the sterno-clavicular articulation are triangular and acutely pointed, contrasting with the irregularly blunt processes of *Ph. larvata*; the carina is greatly developed, forming a deep, quadrilateral projection arising from the entire length of the bone. The second sternal bone is provided with a deep triangular projection, the anterior margin of which is separated from the posterior margin of the carina manubrii by a wide triangular space; behind, the projecting posterior angle conceals the junction of the third sternal bone. The third bone is small, narrow, and spine-like; its posterior extremity supports a thin, semicircular cartilage.

In *Phyllorhina* the carina manubrii is shallow, forming a slightly raised ridge for more than two-thirds its length; in the anterior third it is produced into a blunt spine. The second sternal bone develops a shallow keel along its entire length; the third bone is short, expanded laterally, terminating in a semicircular margin.\*

\* This is the most usual form of the sternum in insectivorous bats. (See Blainville, *Ostéographie*). The number of bones here given is the number of separable bones distinguishable in the sternum of an adult specimen.

The ribs are very much flattened and separated by very narrow intervals.

The ento-condyloid tuberosity of the humerus develops an exceedingly long styloid process, directed slightly upwards, contrasting with the similar, short, blunt process of *Phyllorhina*; the ecto-condyloid tuberosity is obsolete; the articular surface is marked with a very deep sigmoid notch.

The ulva is strongly curved backwards.

The bones of the fingers exhibit nearly the same relative proportions in length as in *Phyllorhina*. The terminal phalanx of the third finger only is bifid at the extremity, as in *Cælops Frithii*. From the proximal extremity of the same phalanx, close to the joint, on the under surface, and slightly to the outside, a process of bone, 0.15 inch long, arises, directed downwards, slightly forwards, and outwards.

The anterior portion of the ilium develops, at right angles to its inferior surface, a broad quadrilateral process of bone. The antero-inferior angle of this process is connected by a narrow bony isthmus with the ileo-pectineal spine, thus bridging over the space between, and forming the inferior boundary of a large oval opening, larger than the obturator foramen which is placed posterior to it, and, owing to the oblique position of the iliac bones, on a somewhat lower level. The rim of the pelvis thus forms a straight line from the pubic symphysis to the antero-inferior angle of the quadrilateral process on the anterior extremity of the ilium.

In *Ph. larvata*, and other species of *Phyllorhina*, the iliac bones develop very similar processes, but that rising from the antero-inferior surface of the ilium is much narrower, more of a triangular than of a quadrilateral shape, and directed downwards and slightly backwards; its antero-inferior angle is rounded off, and does not develop any spine, as in *Triænops*.

In *Rhinolophus* the *eminentia ileo-pectinea* develops a long, acutely pointed spine, not connected by bone with the antero-inferior surface of the ilium.

The fibula is complete as in other Rhinolophine bats. The toes are equal in length, each with two joints, as in *Phyllorhina* and *Cælops*.

The genera of *Rhinolophidæ* may be arranged, osteologically, under two subfamilies as follows:—

*Subfam. I. RHINOLOPHINÆ.*

Toes unequal; outer toe with two, remaining toes with three joints each; ileo-pectineal spine not connected by bone with the antero-inferior surface of the ilium.

*Genus. 1. Rhinolophus.*

Metacarpal bone of fourth finger exceeding that of second finger in

length; foramen rotundum united with sphenoidal fissure; roof of mesopterygoid fossa with a longitudinal groove terminating in an excavation posteriorly; basi-occipital between auditory bullæ very narrow, in most species linear; par-occipital processes slender, produced; antero-posterior diameter of last molar equal to more than three-fourths that of antepenultimate molar; premolars  $\frac{2-2}{3-3}$ .

*Subfam. II. PHYLLORHININÆ.*

Toes equal, with two joints each; ileo-pectineal spine united by bone with a process derived from antero-inferior surface of ilium.

*Genus. 2. Phyllorhina.*

Metacarpal bone of fourth finger less than that of second finger in length; foramen rotundum distinct; auditory bullæ separated by a broad basi-occipital; roof of mesopterygoid fossa continuous with under surface of the *basis cranii*, not grooved, nor perforated by foramina; par-occipital processes short, blunt; zygomata narrow, slightly expanded posteriorly, curved outwards; antero-posterior diameter of last molar less than half of the antepenultimate molar; premolars  $\frac{2-2}{2-2}$ , or  $\frac{1-1}{2-2}$ .

*Genus. 3. Triænops.*

Metacarpal bone of fourth finger less than that of second finger in length; foramen rotundum united with sphenoidal fissure; basi-occipital between auditory bullæ narrow, not linear; roof of mesopterygoid fossa pierced by foramina, not grooved, continuous posteriorly with under surface of *basis cranii*; par-occipital processes long, slender; zygomata greatly expanded vertically, not curved outwards; last upper molar equal to three fourths of the antepenultimate molar; mandible pierced by an infra-condyloid foramen; premolars  $\frac{2-2}{2-2}$ .

*Genus. 4. Cælops.\**

Metacarpal bone of index finger very long, extending beyond the first phalanx of the second finger; metacarpal bone of fourth finger exceeding that of second finger in length; basi-occipital broad between auditory bullæ; zygomata slender, curved outwards; last upper molar equal to three-fourths of the antepenultimate molar; tail very short or absent; premolars  $\frac{2-2}{2-2}$ .

*Explanation of plate vi.*

Figs. 1-9. *Triænops persicus*, Dobson. 1. Side view of skull; 1a, base of skull; 1b, lower jaw; all enlarged double the natural size; 2, scapula, double size; 3, side view of thorax, showing the very prominent *carina sterni*, enlarged double natural size; 4, 4a, distal extremity of humerus, enlarged four times the natural size; 5, third

\* Type *Cælops Frithii*, Blyth, Journ. As. Soc. Bengal. Dr. W. Peters has noted the relations of this genus with *Phyllorhina*. (See Monatsber. Berlin Akad., 1865, p. 644, and also for 1871).

finger showing peculiar form of terminal phalanx, enlarged double natural size; 6, proximal third of forearm, enlarged double; 7, front view of pelvis; 8, side view of pelvis, both enlarged double; 9, tibia and fibula, enlarged double.

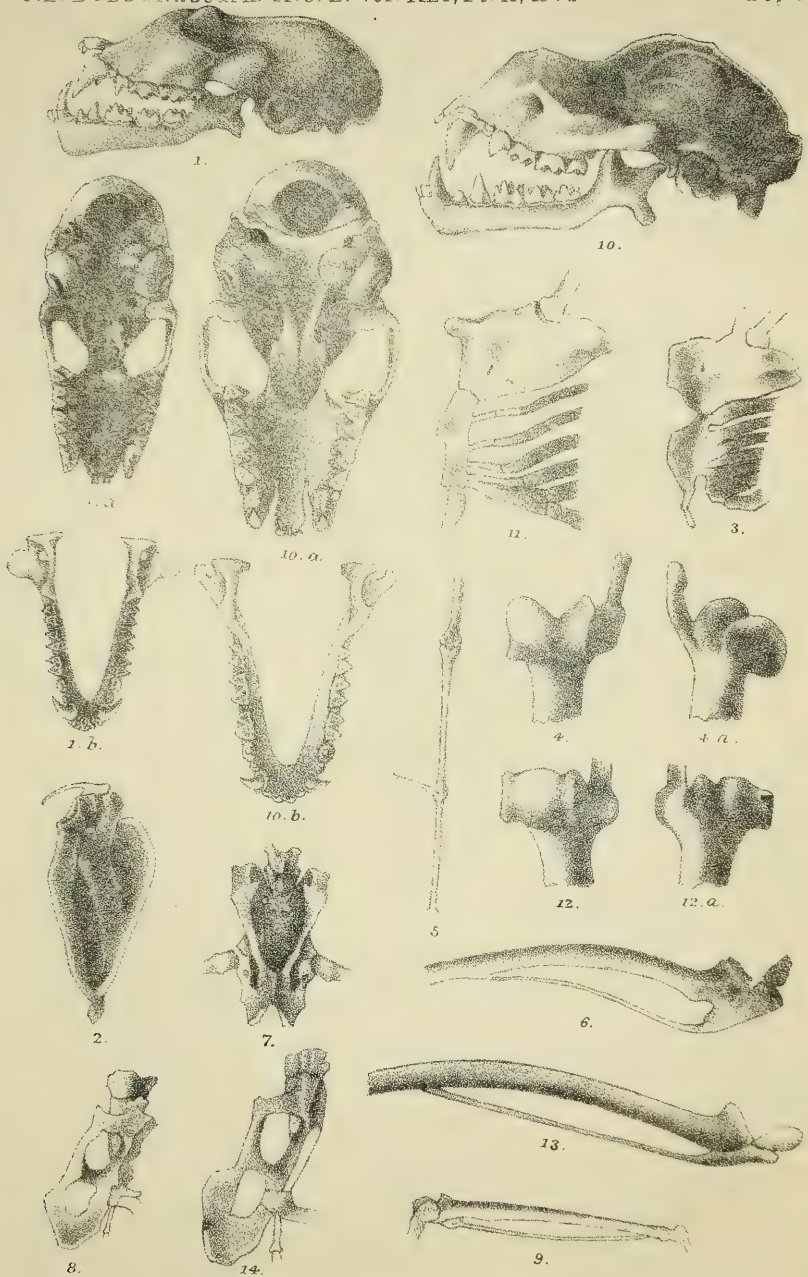
Figs. 10-14, *Phyllorhina larvata*, Horsfield. 10, 10a, 10b, side and base of skull with lower jaw, all enlarged double natural size; 11, side view of thorax, double size; 12, 12a, distal extremity of humerus enlarged about three times the natural size; 13, proximal third of forearm, enlarged double; 14, side view of pubic and iliac bones, enlarged double.

THIRD LIST OF BIRDS OBTAINED IN THE KHASI AND GARO HILL RANGES,  
WITH SOME CORRECTIONS AND ADDITIONS TO THE FORMER LISTS,—by  
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- 23.\* *Micronisus badius*, Gmel. Foot of Garos.  
211. *Chrysococcyx Hodgsoni*, Moore. Garo Hills.  
234. *Arachnechthra asiatica*, L. Bolagunj.  
297. *Alseonax latirostris*, Raffles. Garo Hills.  
304. *Cyornis rubiculoides*, Vigors.  
312. *Muscicapula sapphira*, Tickell. Shoton Dorengo Peak, Garo range.  
318. *Siphia tricolor*, Hodg.  
350. *Zoothera monticola*, Blyth.  
358a. *Turdus dissimilis*, Blyth. *T. hortulorum* of Sclater. Garo Hills.  
399a. *Pellorneum palustræ*, Jerdon, n. sp. Obtained in the beels between Bolagunj and Chatak.  
468. *Iora typhia*, Linn.  
453. *Ixos tristis*, Blyth.  
476. *Kittacincla macroura*, Gmel.  
519. *Dumeticola affinis*, Hodg. Banks of Megna, Sylhet.  
522. *Tribura luteoventris*, Hodg.  
544. *Drymoipus longicaudatus*, Tickell.  
547. *Suya criniger*, Hodg.  
562. *Phylloscopus indicus*, Jerdon. Base of Garos.  
594. *Budytes citreoloides*, Hodg.  
693a. *Calornis affinis*, Walden.  
704. *Estrela amandava*, Linn.  
738. *Carpodacus erythrinus*, Pallas.  
829. *Coturnix communis*, Bonaterre. Cherra Punji. October.  
904. *Gallirex cristatus*, Latham.

\* Numbers same as in Jerdon's Birds of India.



*Osteology of Trienops persicus*  
(For explanation see p. 141)